Golder Associates Ltd.

1011 6th Avenue S.W.
Calgary, Alberta, Canada T2P 0W1
Telephone (403) 299-5600
Fax (403) 299-5606

Golder Associates

REPORT ON

THE OLDMAN RIVER BULL TROUT RADIO TELEMETRY STUDY, 1995

Submitted to:

Alberta Environmental Protection
Pincher Creek, Alberta

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EXECUTIVE SUMMARY

Fish sampling was conducted in the Oldman Reservoir to obtain 20 adult bull trout for radio tagging and release to the reservoir. Sampling was conducted by boat electrofishing in the vicinity of the mouths of the three main tributary streams of the reservoir; the Crowsnest, Castle and north fork Oldman rivers. Sampling was conducted during the period 6-15 July, 1995.

A total, 54 bull trout were captured and released, of which 41 were Floy tagged and 15 also received an internally implanted radio transmitter. The number of bull trout captured that were large enough to receive implanted transmitters was not sufficient to provide the target number of 20 radio tagged fish. Nine of the radio tagged bull trout were captured, tagged and released in the vicinity of the Crowsnest River mouth and the remaining six originated from near the mouth of the north fork Oldman River. No radio tagged fish originated from the mouth of the Castle River.

Movements and spawning activities of the radio tagged bull trout in the Oldman River Basin were monitored through aerial telemetry surveys conducted roughly once every two weeks from 18 July to 14 October. However, due to failure of the radio transmitters in September, positional data for the radio tagged fish are only available until 5 September. Analysis of the previous telemetry results from 1993 and 1994 determined that most, but not all, bull trout were present in the spawning tributaries by this date. Therefore, the results of this telemetry study may not provide spawning locations for all of the radio tagged fish.

Results of the radio telemetry surveys showed that almost half (47%) of the radio tagged bull trout remained in the Oldman Reservoir during the 1995 telemetry period while the remainder migrated from the reservoir. Of the eight fish that left the reservoir, one was a part time resident in the Crowsnest River and seven ascended the north fork Oldman River. Movements out of the reservoir occurred in late July or early August. Radio tagged fish were present in the north fork Oldman River from 1.0 to 20.8 km upstream of reservoir FSL, with multiple fish recorded from three sections of the river; 5.0 to 6.4 km, 10.8 to 11.0 km, and 20.8 km above FSL. The redd surveys did not document any spawning sites at any of the locations frequented by the radio tagged bull trout during the fall (late August-early September) telemetry surveys.

Compared to previous years of the Oldman River Basin biotelemetry study, bull trout from the Oldman Reservoir did not undergo extensive migrations in 1995. Both the origin and destination of the bull trout differed in this study compared to results from 1993 and 1994. The differences between the results from 1995 and the previous years is believed to be due to differences in the size of the fish which were radio tagged and their location of capture. In 1993 and 1994, radio tagged bull trout originated primarily from downstream of the dam or from the Castle River mouth and were larger than those encountered upstream of the dam in 1995. Results from 1993 and 1994 showed that the majority of the fish which left the reservoir ascended the Castle River system to spawn in tributary streams. In 1995, the number of radio tagged bull trout that were small enough to potentially be immature fish was higher than in previous years, with a number of fish originating from the mouth of the north fork Oldman River for the first time. It is likely that movements for a number of radio tagged bull trout recorded in 1995 may reflect locations of feeding and rearing areas rather than spawning sites.

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TABLE OF CONTENTS

SECTION	PAGE
1.0 INTRODUCTION	1
2.0 METHODS AND MATERIALS	3
2.1 Study Area	3
2.2 Fish Sampling and Radio Tag Implantation	3
2.2.1 Fish Capture Techniques	4
2.2.2 Fish Sampling and Tagging Procedures	4
2.3 Radio Telemetry Data Collection	6
2.3.1 Radio Telemetry Equipment	6
2.3.2 Radio Telemetry Surveys	7
2.4 Redd Surveys	7
3.0 RESULTS AND DISCUSSION	8
3.1 Fish Sampling Results	8
3.1.1 Bull Trout	8
3.1.2 Other Fish Species	9
3.2 Radio Telemetry Results	10
3.3 Redd Surveys	14
4.0 SUMMARY AND CONCLUSIONS	15
5.0 CLOSURE	20
6.0 REFERENCES	21

LIST OF TABLES

Table 1	Summary of Bull Trout Captured in the Vicinity of the Oldman Reservoir, 6-15 July 1995	8

LIST OF FIGURES

Figure 1	Location of Oldman River Radio Telemetry Study Area
Figure 2	Oldman River Radio Telemetry Study Area in Detail Showing Sampling Locations
Figure 3	Length-frequency Analysis for Bull Trout from the Oldman Reservoir Study Area, July 1995

LIST OF APPENDICES

Appendix I Summary of Capture and Tagging Information for Bull Trout from the Oldman Reservoir Study Area, July 1995
Appendix II Individual Bull Trout Telemetry Locations, Oldman River Basin, 1995

1.0 INTRODUCTION

The Oldman Dam was completed in 1991 to meet multiple-use objectives for the Oldman River. During the years 1989 to 1992, a fish enumeration, tagging and transport study was conducted by Alberta Public Works, Supply and Services (APWSS) to collect salmonids from downstream of the dam and transport adult fish around the dam, providing them with access to traditional spawning areas (EMA/R.L&L. 1992; 1994).

To determine how bull trout (*Salvelinus confluentus*) and rainbow trout (*Oncorhynchus mykiss*) respond to the operation of the reservoir and to provide a scientific basis for managing these species in the Oldman River Basin, a radio telemetry program was initiated in 1993. The objective of the 1993 study was to determine the movement patterns and spawning locations for these two species, both upstream and downstream of the dam, and, incidentally, the numbers of salmonids still present below the dam. During the spring of 1993 radio transmitters were implanted in a small number of rainbow and bull trout originating from below the dam. A portion of the radio tagged fish were released upstream of the dam while the remainder were released below the dam. These fish were subsequently monitored to determine seasonal movement patterns and spawning locations (Golder 1996a).

Results of the 1993 telemetry study provided information concerning the movements and spawning locations for bull trout in the Castle River system upstream of the dam, and documented movements of fish over the dam and the amount of angler pressure downstream of the dam. In 1994, further telemetry work was conducted to increase the level of knowledge concerning bull and rainbow trout movements, habitat use and spawning locations in the Oldman River Reservoir and its various tributary systems (Golder 1996b).

A radio telemetry study was commissioned for 1995 to continue the study of bull trout movements and spawning activities in the Oldman River Basin upstream of the Oldman Dam. The study design involved radio tagging a target number of 20 bull trout, with specimens to be captured from each of the three tributary arms of the reservoir to maximize the probability that fish movements and spawning activity would be recorded in each of the three tributary systems. Seasonal movements of the radio tagged bull trout were monitored with aerial telemetry surveys and the

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locations utilized by the fish during the fall spawning period were examined during ground-based [redacted]d surveys for the presence of spawning sites.

2.0 METHODS AND MATERIALS

2.1 Study Area

The Oldman Dam is located in southwestern Alberta near the town of Pincher Creek (Figure 1) and is situated downstream of the confluences of the Oldman, Castle and Crowsnest rivers. Figure 2 shows the location of the dam and details of the Oldman River system upstream and downstream of the damsite.

The sites sampled during the fish capture portion of this study were located upstream of the dam and included the mouths of the three main reservoir tributary streams. The radio telemetry study area during the aerial surveys consisted of the Oldman Reservoir, the north fork of the Oldman River (up to and including the lower portions of Dutch and Racehorse creeks), a short portion of the lower Crowsnest River (up to Lundbreck Falls), and the Castle River Basin, including portions of the following: the mainstem Castle River, West Castle River, Mill Creek, Gladstone Creek, Whitney Creek, Beaver Mines Creek, Lost Creek, North Lost Creek, and the Carbondale River (Figure 2). Key areas flown on all flights included the entire reservoir, the lower portion of the north fork of the Oldman River (i.e., below the Gap at Racehorse Creek), the Crowsnest River from the reservoir to Lundbreck Falls, and the Castle River mainstem and major tributaries. Other areas flown as time and weather permitted included Beaver Mines Creek, the upper portion of the north fork of the Oldman River (i.e., above the Gap), and the Oldman River from the dam downstream to Summerview Bridge.

2.2 Fish Sampling and Radio Tag Implantation

Sampling efforts were designed to procure a target of 20 adult bull trout from upstream of the Oldman Dam for inclusion in the radio telemetry study. Collection of fish from the Oldman River immediately below the dam was to occur if the numbers of bull trout captured in the reservoir were insufficient. Fish capture operations were conducted over the period 6-15 July, 1995.

Extremely high flow conditions occurred in the Oldman River Basin during the spring of 1995 (highest flows ever recorded in June). At the time of sampling, flow conditions remained high in

two of the three tributary streams to the reservoir and conditions were extremely turbid, providing poor conditions for sampling. The Crowsnest River was less turbid than the Castle and north fork Oldman rivers; moderate discharges provided improved sampling conditions. The Oldman River downstream of the dam was still experiencing extremely high flows and turbidities due to high reservoir releases and sampling below the dam was not possible. Access to boat launch facilities downstream of the dam was hindered by road closure resulting from washout of the Cottonwood Park bridge located downstream of the dam during the flooding.

Sampling was restricted to locations upstream of the dam and was conducted near the mouths (reservoir confluence) of the three main tributary streams. The three sampling areas are illustrated on Figure 2 and are detailed as follows: 1) the Castle River from the Castle River Recreation Area located 3.2 km upstream of reservoir FSL downstream to the Highway 3 bridge crossing in the Castle arm of the reservoir; 2) the Crowsnest River from just upstream of the mouth of Todd Creek downstream into the Crowsnest arm of the reservoir; and, 3) the north fork Oldman River from 1 km upstream of FSL downstream to the North Fork Recreation Area in the Oldman arm of the reservoir.

2.1 Fish Capture Techniques

Fish were captured by boat electrofishing. The equipment utilized for this study consisted of a Smith-Root Model SR-18 electrofishing boat equipped with a work station, flow-through live well, and a Model 5.0 GPP electrofisher powered by a 5000 watt generator. The boat was propelled by a 115 hp outboard jet motor.

During electrofishing operations, larger sized, stunned bull trout were selectively captured and placed in the live well. Smaller bull trout were also captured, when possible. The bull trout were then processed and fish of suitable size were radio tagged.

2.2 Fish Sampling and Tagging Procedures

Captured bull trout were enumerated, measured for fork length and weight, and examined for any of the tags or marks previously used during the fish transport or telemetry programs. Also

recorded for each trout captured was sex, life stage (fry, juvenile or adult), and state-of-maturity (green, gravid, ripe, spent), when discernible from external examination or during surgery for fish receiving radio tags. Bull trout larger than 300 mm in fork length were tagged using an orange, numbered, reward Floy tag (type FD 67 anchor tag). Fish smaller than 300 mm were released unmarked. During electrofishing efforts, all larger bull trout were retained in the live well until the entire area being sampled was completed, while smaller fish were released following processing. Selected trout were radio tagged on the day they were captured and were released at their point of capture.

Fish were selected for radio tagging based on size (≥ 820 g) and good physical condition. The minimum weight requirement was necessary to ensure that the transmitter weight was no more than 2% of the fish's body weight. During radio tag implantation, all tagging equipment was arranged in a work area on a portable table and surgical equipment was placed in a disinfectant bath followed by a distilled water rinse. Every effort was made to maintain as sterile an environment as possible. Surgical gloves were used and were changed as each fish was processed. The individual fish was placed in an anaesthetic bath of 5 g of tricaine methane sulfonate (MS-222) in 35 L of water for a period of two to four minutes. During this time the respiration rate and physical movements (coordination) of each fish was visually monitored until the fish was determined to be anaesthetized.

The surgical implantation technique used was modified from Bidgood (1980) and Knecht *et al.* (1981). During surgery, a 3-4 cm longitudinal, abdominal incision was made about 1-2 cm from the mid-ventral line, anterior to the pelvic fins. A large diameter (16 g) hypodermic needle was inserted about 2 cm posterior to the incision, into the abdominal cavity and out of the incision, without damaging the internal organs. The radio transmitters' whip antennae was then inserted into the hypodermic needle and drawn out of the body cavity through the needle hole. The radio transmitter was positioned inside the body under the incision and an antibiotic (Lyquamycin) was injected intraperitoneally to reduce the possibility of infection. Three sutures in an interrupted pattern were used to close the incision and the incision area was treated with a fungicide (Methyl Blue). A liquid suture (Vetbond tissue adhesive) was applied over the incision to seal it. Following surgery the fish was returned to an isolated section of the flow-through live well and held for recovery. Recovery times were short and when it was determined that the fish could swim

strongly with no disorientation it was released. Fish were released after about one to two hours of observation. Reduced holding time for surgically stressed fish was noted by Hart and Summerfelt (1975) to minimize trauma. After tag implantation, each tag was tested using the telemetry receiver with the fish in the water to determine exact operating frequencies. All frequencies were then entered into the receiver. For each fish the number on the Floy tag, radio number and radio frequency were recorded.

In addition to the fish processing conducted for the tagging and telemetry study, tissue samples were collected from a selected number of bull trout for DNA analysis. These samples were collected at the request of the Regional Fish and Wildlife Services Office in Lethbridge for a study being conducted by researchers at the University of Lethbridge. These researchers use DNA assays to fingerprint Alberta bull trout populations to determine the degree of genetic diversity, existence of genetically distinct populations in different drainages, and the level of interbreeding among different trout species. Tissue samples consisted of approximately 50 mg of tissue collected from the caudal or adipose fin of each specimen.

2.3 Radio Telemetry Data Collection

2.3.1 Radio Telemetry Equipment

Encoded radio tags (transmitters), weighing 16.4 g (weight in air) were used for the study and were supplied by Custom Telemetry and Consulting, Inc. The transmitters emitted frequencies in the 150 MHz range, and had an average minimum life expectancy of 7.8 months and a pulse rate of 55 beats per minute. A Telonics TR-2 receiver was used to locate the transmitter signals during both ground and aerial surveys. Yagi antennas were used during telemetry surveys and consisted of either a single hand held antenna (ground surveys) or 2 antenna mounted to opposite wing struts of a Cessna 172 (aerial surveys). Before transmitter frequencies were selected for use in this study, the frequencies used in the 1994 telemetry program were excluded in case some of these transmitters were still active during the early stages of the 1995 study. Frequencies were also checked against a list of transmitters used by Alberta Environmental Protection for their deer telemetry program in the same study area.

One of the radio transmitters that was not implanted into a fish was set aside and used as a reference transmitter. This transmitter was turned on during the field program in July and was left running to mimic the activity of the implanted transmitters. It was left on to act as a check on the battery life of the implanted transmitters, to indicate when the implanted transmitters might be failing or losing transmission power. The reference transmitter was also used to test the telemetry equipment after it was set up in the aircraft to ensure it was operational for each flight.

2.3.2 Radio Telemetry Surveys

A total of 7 aerial telemetry surveys were conducted and occurred on the following dates; 18 July, 4 and 21 August, 5, 19 and 28 September, and 14 October, 1995. All flights were chartered out of Calgary utilizing All West Air Services Ltd., which had provided charters for the Oldman telemetry studies in previous years. Key areas were flown on each flight, with other areas flown as time and weather conditions permitted. During each flight, the frequency and location of each transmitter relocated was recorded on 1:50,000 scale NTS maps. Following each flight the information was then transferred to digitized maps of the study area developed using ArcInfo GIS software.

Ground-based telemetry surveys were conducted on 17 and 18 October, 1995. These surveys were conducted opportunistically during the fall redd surveys and covered only a limited portion of the overall study area. They were conducted in areas that the aerial surveys had determined were recently frequented by the radio tagged bull trout and were used to attempt to locate fish at the time of the redd surveys.

2.4 Redd Surveys

Redd surveys were conducted during the fall bull trout spawning period in order to locate the spawning sites utilized by the radio tagged fish. Ground-based redd surveys were conducted to locate and document the spawning areas, with the redd survey locations dictated by the radio telemetry results. Visual observations were used to identify redds and the telemetry receiver was used to check for the presence of radio tagged bull trout. The fall redd survey was conducted during the period 17-18 October.

3.0 RESULTS AND DISCUSSION

3.1 Fish Sampling Results

Table 1 presents the capture results from the reservoir for each of the three different sampling locations, to provide some indication of the relative abundance and distribution of fish species and the origin of the fish which were radio tagged. Figure 3 presents the length-frequency analysis for all bull trout captured during the study. A complete listing of the sampling and tagging data for the bull trout that were captured is presented in Appendix I.

TABLE 1

SUMMARY OF BULL TROUT CAPTURED IN THE VICINITY OF THE OLDMAN RESERVOIR, 6-15 JULY 1995

Location	Electrofishing Effort (sec)	Number of Bull Trout				
		Juvenile	Adult	Unknown	Total	Radio Tagged
Castle River mouth	12, 006	6	1	3	10	0
Crowsnest River mouth	9, 357	6	7	10	23	9
Oldman River mouth	11, 884	13	1	7	21	6
TOTAL	33, 247	25	9	20	54	15

3.1.1 Bull Trout

In total, 54 bull trout were captured during electrofishing sampling of the 3 reservoir tributary areas, of which 41 were Floy tagged. The number of large, adult bull trout captured during sampling activities was limited. Of these 54 fish, 16% (n=9) were classified as adult, with the remainder classified as juvenile or of unknown life-history stage. For most of these fish, classification was based on size and external examination. The bull trout that were captured ranged in size from 216 to 553 mm in fork length and 120 to 2010 g in weight. Figure 3 shows that the two largest size classes were 351-400 mm and 401-450 mm. Only five fish were captured that measured >500 mm in length.

A total of 15 bull trout were tagged with radio transmitters. This was the maximum number of fish captured which were large enough and in good enough condition to receive implanted transmitters. Relatively low capture rates during the sampling period did not provide a sufficient number of candidates for radio tagging to meet the target number of 20. Low capture rates were most likely a result of the poor sampling conditions experienced during electrofishing which included high discharges, and more significantly, poor visibility due to high turbidity levels. The improved conditions present at the Crowsnest River mouth are likely responsible for the higher capture rates at this location. In addition to sampling conditions, the sampling period was different from previous years. Sampling was conducted during the spring in previous years and it is possible that a percentage of the adult bull trout present in the reservoir in the spring had left the reservoir by the start of the sampling period in July.

Catch-per-unit-effort (CPUE) values calculated for the study area show that the highest capture rate occurred at the Crowsnest River mouth (0.25 fish/100 seconds), followed by the Oldman River mouth (0.18 fish/100 sec) and the Castle River mouth (0.08 fish/100 sec). Most of the bull trout which received radio transmitters were captured in the vicinity of the Crowsnest River (9), while the remainder (6) were captured near the mouth of the north fork Oldman River. In contrast to the previous (1994) telemetry study (Golder 1995), none of the radio tagged bull trout came from the vicinity of the Castle River in 1995. During sampling in late April and mid May in 1994, when gill net sampling was conducted as well as electrofishing, bull trout from upstream of the dam were primarily captured from the Castle arm, and there were no fish captured from the Oldman arm (north fork) of the reservoir that were large enough to be included in the telemetry study.

DNA samples were collected from a total of 36 bull trout, including 9 from the Castle River, 13 from the Crowsnest River and 14 from the north fork Oldman River. These samples have been delivered to Don Groft, Department of Biological Sciences at the University of Lethbridge.

3.1.2 Other Fish Species

Fish species other than bull trout were not retained or enumerated during electrofishing efforts but were qualitatively recorded by presence and relative abundance in each of the three sampling areas. In the lower Castle River and Castle arm of the reservoir the most numerous species were

mountain whitefish (*Prosopium williamsoni*) and longnose sucker (*Catostomus catostomus*), which were rated as abundant. Rainbow trout were also present and were rated as common. In the vicinity of the Crowsnest River, rainbow trout were the most numerous species and were rated as abundant, as were longnose sucker. Mountain whitefish were common in this area while brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), white sucker (*Catostomus commersoni*) and lake trout (*Salvelinus namaycush*) were recorded as present [as the single lake trout which was captured in the Crowsnest arm was a rare occurrence, this fish was Floy tagged]. In the vicinity of the north fork Oldman River no species was rated as abundant although longnose sucker were common. Also present were rainbow trout, mountain whitefish and brown trout.

3.2 Radio Telemetry Results

The original study plan was to conduct biotelemetry aerial surveys from the time of transmitter implantation in July until early December, with flights occurring approximately once every two weeks. Radio telemetry aerial surveys were, in fact, conducted from 18 July to 14 October. It was discovered during the aerial survey on 19 September that the reference radio transmitter which was used to test the equipment before each flight had failed. During this same flight, none of the radio tagged fish were located. The manufacturers of the radio transmitters were contacted and Golder was informed that a reference transmitter from this batch was also retained by the manufacturer and that this transmitter had "drifted" from its listed frequency and was now transmitting at a higher frequency. Golder rechecked the reference transmitter and found that it had also drifted and was transmitting 30 kHz higher than its listed frequency. Golder was informed that if the implanted transmitters had also drifted, they would also be transmitting at a higher frequency.

Two more aerial telemetry surveys were conducted in the Oldman River study area in an attempt to locate the radio tagged fish. These surveys were conducted with the original frequencies programmed into the receiver as well as additional higher frequencies for each transmitter but were unsuccessful in locating any of the fish. The reference transmitter was sent to the manufacturer for examination and it was determined that the battery seals were broken when the manufacturer spot welded the tabs on the lithium crystal batteries used in the tags, and that the amount of drift that would occur could not be predicted.

Transmitter location results from the telemetry flights are available up to and including 5 September. Results from the telemetry studies conducted for the Oldman Reservoir in 1993 determined that spawning bull trout were present at the documented spawning sites by 2 September at the latest, with some fish in place by 19 August. In 1994, the telemetry results similarly demonstrated that most fish were at the spawning sites by late August or early September. However, with the larger number of radio tagged bull trout monitored in 1994, it was also found that some fish did not migrate to their spawning areas until late September or early October. Therefore, it seems likely that most bull trout would have been on their spawning grounds prior to or during the 5 September survey in 1995, but also that some fish may not have made this migration before the transmitters failed.

Results of the radio telemetry program are presented in detail in Appendix II. This appendix presents an individual digitized GIS map for each radio tagged fish, showing all the sites from which the individual transmitter signal was received and illustrating the movements for each fish. Information presented on the maps includes the following; fish species, transmitter frequency (identifier), Floy tag number, tagging/release date, fish measurements, capture/release location, all survey dates, and transmitter location results for each survey. The maps are arranged in order of transmitter frequency.

The radio transmitters utilized for this study were high frequency transmitters and are therefore best suited to the shallow depths typical of the riverine habitats in the study area, and are extremely effective under these conditions. However, for radio tagged fish which remain in the reservoir at depths >5 m, reception of the telemetry signal would be disrupted, as the range of a radio transmitter decreases almost exponentially as depth increases (Winter 1983); the higher the radio frequency used, the more restraining are the effects of depth (Oregon Fish and Wildlife 1988). Therefore, for fish for which no transmitter signal was received for prolonged periods, and for which previous data did not indicate large scale movements from the reservoir, it was generally assumed that the individual was present in the reservoir at a depth which precluded reception of the transmitter signal. This assumption is supported by the data for a few fish which, after periods without being located, were then relocated in or near the reservoir. For fish whose transmitter signals were lost, it is also possible that they either moved into a portion of the Oldman River Basin not included in the telemetry study area, or they were removed by an angler but not reported.

In total, 15 bull trout were captured, radio tagged and released upstream of the Oldman dam, near the mouths of the Crowsnest and north fork Oldman rivers. From the results of the aerial telemetry surveys, seven bull trout were known or assumed to have remained in the Oldman reservoir throughout the study period (18 July - 5 September) and it was documented that eight of the radio tagged fish migrated from the reservoir. The majority of these bull trout (seven) ascended the north fork Oldman River while the remaining fish moved upstream into the Crowsnest River. For the fish which left the reservoir, most upstream movements occurred in late July or early August.

Of the 15 radio tagged bull trout, two fish were not located at any time during the telemetry program. Both of these fish (frequencies 150.337 and .385) originated from the vicinity of the north fork Oldman River. These fish are believed to have been resident in the reservoir throughout the period of the telemetry study. A third fish (frequency 150.284), originating from the Crowsnest River mouth, was not located until 19 September when a signal of this frequency was located in Dutch Creek (Figure 2). This frequency was located after the date that the transmitters failed and was, therefore, a suspicious location. It was determined that other researchers were working with radio tagged cutthroat trout in Dutch Creek. When contacted, these researchers informed us that they had a transmitter which operated on this same frequency and it was assumed that our signal was likely from the foreign transmitter. It was believed that the bull trout with this frequency was resident in the reservoir throughout the study. However, the site in Dutch Creek where this transmitter was located was included in the redd survey.

For four other bull trout, transmitter signals were received only from the vicinity of the Oldman Reservoir. All four fish were tagged and released in the Crowsnest arm of the reservoir. One bull trout (frequency 150.538) was relocated shortly after release at the mouth of the Crowsnest River but was not located again after the first telemetry flight. A second fish (150.916) was relocated on the first telemetry flight in the main body of the reservoir, 9.5 km from its release site. This fish was also not relocated on subsequent surveys. Both these fish are presumed to have been resident in the reservoir throughout the study. The two remaining fish were relocated on several surveys, always within the reservoir. One fish (150.138) was resident in the Crowsnest arm on each of the aerial telemetry surveys, from 0.0 to 3.7 km from its point of release. The other bull trout (150.182) was relocated at various positions in the reservoir. It traveled 15.7 km to the Castle arm of the reservoir by 4 August but returned to the Crowsnest arm by 5 September.

Of the eight radio tagged bull trout which were known to have left the reservoir, one fish moved into the Crowsnest River while seven ascended the north fork Oldman River. The fish which entered the Crowsnest River (frequency 150.880) was originally captured at the mouth of the Crowsnest River. It was relocated 2.1 km upstream of reservoir FSL in July but was not present in the Crowsnest River in August, probably having returned to the reservoir. It was then relocated 0.8 km upstream in the Crowsnest River in early September.

Of the seven bull trout which entered the north fork Oldman River, four were tagged and released in the vicinity of the Oldman River mouth, while three originated from the Crowsnest River mouth. One fish (frequency 150.442) was not located following release at the mouth of the Oldman River until 5 September when it was recorded in the Oldman River 1 km above reservoir FSL. This fish was likely resident in the reservoir until September. Another fish (150.598) moved 3.3 km downstream following release to the Crowsnest arm of the reservoir. On 4 August this fish was recorded at a site 6.4 km upstream of reservoir FSL in the Oldman River, but was not relocated on any of the subsequent telemetry surveys. This fish presumably returned to the reservoir where it remained. A third bull trout (150.580) remained near its capture site at the mouth of the Oldman River in July and was recorded 7.9 km upstream of FSL in the Oldman River in August and 6.0 km upstream of FSL in September.

The four remaining bull trout which ascended the north fork Oldman River were all resident in the river by early August and were recorded to be moving farther upstream on each successive telemetry flight. One fish (frequency 150.666), which originated from the Crowsnest arm, remained in the Crowsnest arm immediately following release but was relocated in the Oldman River on 4 August. During successive flights it was located 5.0, 11.0 and 12.4 km above FSL. Another fish (150.741) moved from its release site in the Crowsnest arm to the mouth of the Oldman River by the first telemetry flight. However, by the second telemetry flight (4 August) this fish was present in the Castle River at a site 17.0 km upstream of reservoir FSL, in the vicinity of the Mill Creek confluence. This fish then returned to the reservoir and was subsequently recorded in the north fork Oldman River 10.9 and 20.8 km above FSL in late August and early September. The third fish (150.715) was captured and released at the mouth of the Oldman River and was relocated 0.4, 5.7 and 10.8 km up the Oldman River from July to early September. The final bull

trout (150.687) also originated from the mouth of the Oldman River and on each successive survey was relocated 2.7, 11, 14.5 and 20.8 km above FSL in the Oldman River.

Redd Surveys

The locations that were examined during the redd surveys included positions of the radio tagged bull trout which were recorded during the 21 August and 5 September aerial telemetry flights. Of the 15 radio tagged bull trout in the Oldman River Basin, 7 fish were present in 2 of the 3 tributary rivers during the fall aerial telemetry flights. As previously described, on 5 September one fish was located 0.8 km above reservoir FSL in the Crowsnest River. In the north fork Oldman River, one fish was positioned 1.0 km above FSL and one was located 6.0 km above the river mouth. The remaining four fish, at some time in the telemetry study, were relocated in the section of the Oldman River from 10.8 to 11.0 km upstream of FSL. Two of these fish were located farther upstream at a site 20.8 km above FSL on 5 September.

The redd survey also included portions of two tributaries of the north fork Oldman River, Dutch and Racehorse creeks. As six of the seven fish were present in the Oldman River, and both Dutch and Racehorse creeks are known bull trout streams, they were included in the redd surveys. In addition, one transmitter frequency was recorded from Dutch Creek during the telemetry flights. Although this frequency was believed to have been transmitted by a cutthroat trout tagged for a different study, the location was examined on the chance that it was one of the bull trout from this study. A 6 km segment of Dutch Creek, beginning at the creek mouth, was surveyed. The survey of Racehorse Creek began at the Racehorse Creek campground and proceeded upstream for 4 km.

No redds were observed at any of the sites examined and no bull trout transmitters were located during the coincidental ground surveys.

4.0 SUMMARY AND CONCLUSIONS

Almost half (47%) of the radio tagged bull trout remained in the Oldman Reservoir during the 1995 telemetry study period. The remainder of the fish moved out of the reservoir, with all but one of these fish ascending into the north fork Oldman River. Due to failure of the radio transmitters, the telemetry study period provided positional data only until 5 September, 1995. Data from the previous telemetry studies in 1993 and 1994 indicate that most, but not all, bull trout were present in the spawning tributaries by this date. Therefore, it is possible that some of the bull trout which remained in the Oldman Reservoir until 5 September may have undergone unrecorded migrations into the reservoir tributary system after the early September aerial survey.

Of the bull trout which left the reservoir, one was a part time resident in the Crowsnest River. The remainder of the radio tagged fish all ascended the north fork Oldman River. Most movements occurred in late July or early August, shortly after transmitter implanting. Radio tagged bull trout were present in a section of the mainstem Oldman River extending from 1.0 to 20.8 km upstream of reservoir FSL. Within this section of river, there were a few locations from which there were multiple bull trout sightings. Four fish spent a portion of their time in the river in an area 5.0 to 6.4 km upstream of FSL and in an area 10.8 to 11.0 km above FSL. Two fish were located in early September at the highest point recorded during the study, 20.8 km above FSL. However, no spawning sites were identified at any of the locations examined during the redd survey.

The largest portion (60%) of the radio tagged fish originated from the vicinity of the Crowsnest River, while the remainder were captured near the north fork Oldman River. None of the radio tagged bull trout originated from the Castle River area of the reservoir. With respect to the fish which were recorded to move out of the reservoir, the location at which they were captured does not appear to be significant. Four of the seven fish which ascended the north fork Oldman River were captured in the vicinity of the river mouth while the remaining three were originally captured at the mouth of the Crowsnest River. However, for fish which were resident in the reservoir or in the Crowsnest River, six out of eight were captured in the vicinity of the Crowsnest River. It may be that, under the conditions noted during the July sampling period, the Crowsnest River with its lower flow and turbidity was the best area for feeding trout, and that bull trout from the reservoir were congregating there.

One bull trout was observed to move from the Crowsnest arm of the reservoir to a site 17.0 km above FSL in the Castle River before returning to the reservoir and ascending the north fork Oldman River. The use of more than one of the three main tributary rivers by the same fish was also recorded during the telemetry surveys in both 1993 and 1994. It appears to occur regularly for a small portion of the bull trout population.

Compared to previous years in the Oldman River telemetry study, bull trout from the Oldman reservoir did not undergo extensive migrations in 1995. In addition, both the origin and destination of the bull trout differed for this study, as compared to results from 1993 and 1994. In 1993, radio tagged bull trout originated from downstream of the dam and were released above the dam. In 1994, bull trout were captured from upstream and downstream of the dam. A portion of the fish originating from above the dam in 1994 were captured from the Crowsnest River area and the majority from the Castle River area; no bull trout large enough to be included in the telemetry study were collected from the mouth of the Oldman River. In both 1993 and 1994, the majority of the radio tagged bull trout ascended the Castle River system, where spawning sites were identified from two of the Castle River tributaries (Golder 1996a; 1996b).

Two potential explanations for the differences in the results of the 1995 telemetry study, as compared to previous years, are the size of the fish that received implanted transmitters and their location of capture. The transmitters that were used in 1995 were lighter than in previous years and allowed tagging of smaller fish. In addition, the number of large bull trout that were captured was lower in 1995.

An analysis of the size and state-of-maturity data for bull trout in the Oldman River Basin was conducted from the data available for the sportfish enumeration and transport studies, 1989-1992 (EMA/R.L.&L. 1992; 1994) and from the 1993-1995 telemetry studies (Golder 1996a; 1996b). From dissection data for the limited number of incidental mortalities, it appears that female bull trout >480 mm in fork length are adults, as are males >460 mm. In addition, bull trout which migrated to spawning tributaries during the 1993 and 1994 studies were all >460 mm in length.

In 1995, only 40% of the radio tagged bull trout exceeded 460 mm in length, compared to 90% in both 1993 and 1994. Although sampling conditions in the Oldman Reservoir were poor in 1995,

the capture results, in terms of total number of fish captured, were similar to those from 1994 for sampling conducted upstream of the dam. The total number of bull trout and the number of adult bull trout captured near the tributary mouths were comparable in 1994 and 1995. The greater number of adult bull trout included in the 1994 telemetry study resulted from the larger fish that were captured below the dam, with seven of the ten largest bull trout originating from downstream of the dam.

The larger number of potentially immature fish included in the 1995 telemetry study would likely have affected the results. Movements of these fish would reflect the locations of feeding and rearing areas rather than spawning sites. Of the seven bull trout that were resident in the reservoir, six were smaller than 460 mm. However, the fish that moved into the Crowsnest River and four of the seven which ascended the north fork Oldman River were >460 mm in length, suggesting at least some of these fish were undergoing spawning movements. Results also suggest that juvenile fish may be using the reservoir and the lower portion of the north fork Oldman River as rearing areas. The combination of smaller radio tagged fish, a greater number of fish originating from the mouth of the Oldman River and no fish originating from the vicinity of the Castle River or from downstream of the dam may explain the differences in fish movement patterns recorded in 1995, as compared to 1993 and 1994.

Results of the 1993, 1994 and 1995 telemetry studies were examined with respect to the extent of the use of the Oldman Reservoir by bull trout. From the 1993 and 1994 studies (Golder 1996a; 1996b) it was evident that a portion of the bull trout population upstream of the dam is utilizing the reservoir for rearing, feeding and overwintering, including a few fish which may be year-round residents. Most bull trout were found to utilize the reservoir for at least a portion of the year, with rearing and feeding activity also occurring in the Castle River drainage. In both 1993 and 1994 the larger portion of the radio tagged bull trout (82% and 69% respectively) migrated from the reservoir while in 1995 half of the fish remained in the reservoir throughout the study.

As almost all the bull trout which remained in the reservoir in 1995 were smaller than 460 mm they may have been juvenile fish, indicating that some juvenile bull trout are year-round residents in the Oldman Reservoir. These fish were recorded to spend the summer and fall period in the reservoir and therefore likely remained for the winter period. During the previous telemetry studies (Golder

1996a; 1996b) radio transmitters were implanted in the early spring. Some of the bull trout present in the reservoir at that time were recorded to remain in the reservoir from early spring through to late fall, providing even stronger evidence of year-round residency. Bull trout which remained in the reservoir during the 1993 and 1994 telemetry studies represented a variety of size ranges with the strongest representation coming from the largest fish (>650 mm in length), which were believed to be fish which were no longer spawning or were not spawning every year. Data from the 1995 telemetry study includes a number of fish < 460 mm for the first time, and also shows the highest degree of reservoir residency. These results in combination with those of the previous studies shows that the Oldman Reservoir provides year-round habitat for juvenile and non-spawning adult bull trout.

Three of the seven fish which left the reservoir for the north fork Oldman River in 1995 were also >460 mm, as was the only other bull trout that entered the Oldman River in the two previous studies (Golder 1996a; 1996b). This would suggest that some of the juvenile bull trout from the Oldman Reservoir rear for a portion of the year in the north fork Oldman River. The remainder of the bull trout which left the reservoir in 1995 were all >460 mm and, in fact, included all but one of the radio tagged fish that was >460 mm. These larger bull trout would represent potential spawners, although no spawning sites were recorded from the locations any of these fish frequented. It appears from the 1993 through 1995 telemetry studies that most of the larger bull trout (i.e., >460 mm), leave the reservoir for rearing, feeding and spawning areas in the tributary systems. Rearing and feeding occurs primarily in the Castle River drainage, with some activity in the north fork Oldman River and a minor amount in the Crowsnest river. All known spawning activity occurs in the Castle River system.

The fish which migrated from the reservoir in 1995 were present in the reservoir during the early July sampling period and may have spent the previous winter and spring in the reservoir. They left the reservoir in late July or early August to summer in the Oldman or Crowsnest rivers. Some of these fish returned to the reservoir for a portion of the summer and utilized both the river and the reservoir during this period. The radio telemetry monitoring does not include the late fall period and it is not known if these fish returned to the reservoir to overwinter, although it would seem likely that they did. In 1993 and 1994, when the radio transmitters were implanted in the early spring, bull trout were recorded as leaving the reservoir at various times of the year, from early

spring (May) through to as late as the fall spawning period (October). The previous studies (Golder 1996a; 1996b) monitored bull trout movements through the fall and determined that some fish returned to the reservoir following the spawning period. The other fish showed some downstream movements by the end of the monitoring period and likely also returned to the reservoir to overwinter.

In summary, juvenile and adult bull trout utilize the Oldman Reservoir for overwintering. A significant portion of bull trout <460 mm in length and a small portion of trout >460 mm remain as residents in the reservoir through the spring, summer and fall, rearing and feeding in the reservoir. The greatest portion of the large bull trout (i.e., >460 mm) spends time rearing and feeding in tributary streams of the reservoir, particularly in the Castle River drainage and to a lesser extent in the north fork Oldman and Crowsnest River mainstems. These fish leave the reservoir anytime from May to October. Some of the smaller bull trout spend the summer rearing in the north fork Oldman River.

In order to ensure results are comparable, future telemetry studies in the Oldman River system should restrict radio transmitter implanting to bull trout >460 mm in fork length. This will provide the greatest probability that adult fish will be included in the study. In addition, transmitter implanting should occur in the early spring when the number of large bull trout present in the reservoir is highest.

5.0 CLOSURE

We trust that this report presents the information that you require. Should any portion of the report require clarification, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

Report prepared by:

Chris Bjornson, B.Sc.
Project Biologist

Report reviewed by:

David A. Fernet, M.Sc., P.Biol.
Principal

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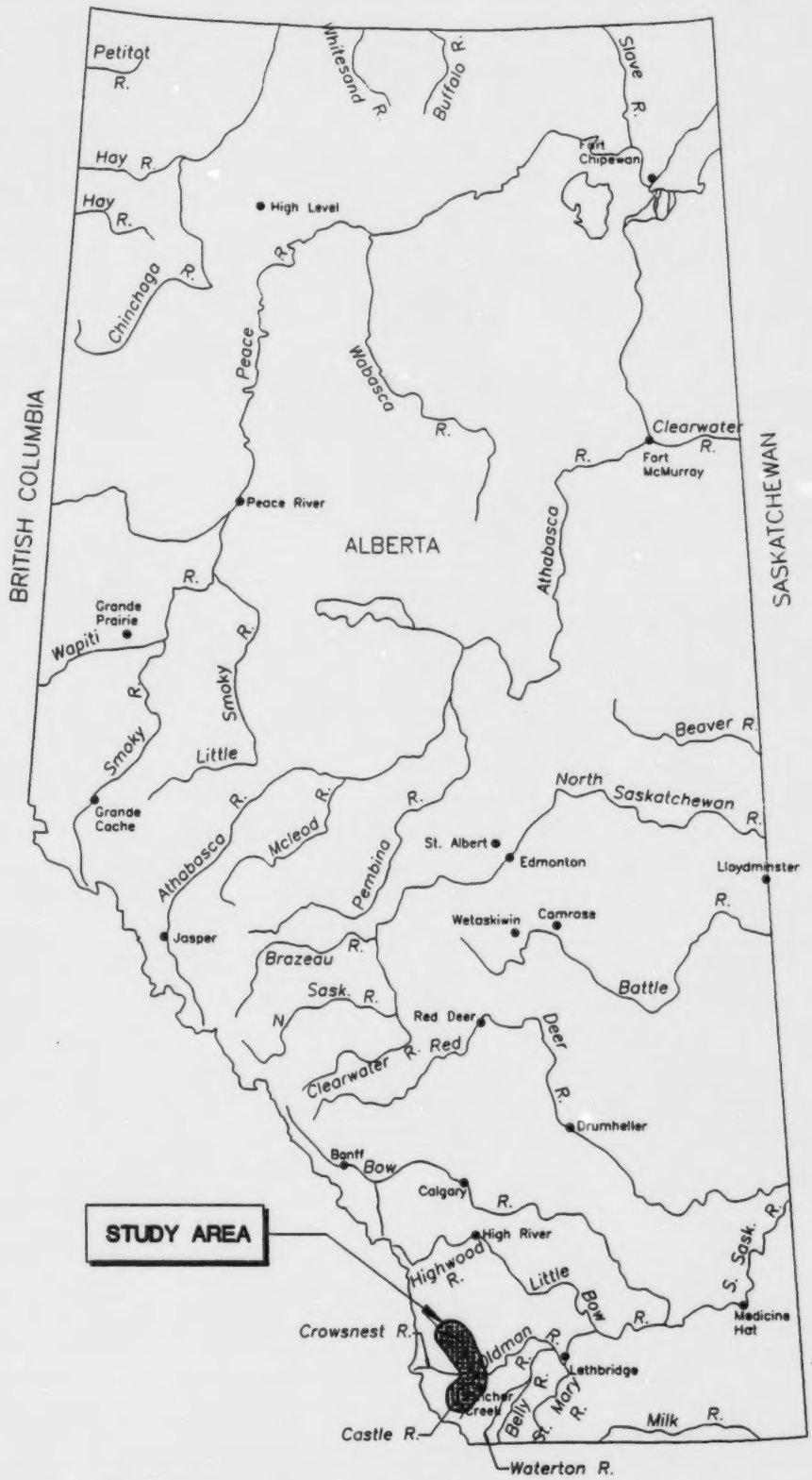
LOCATION OF OLDMAN RIVER RADIOTELEMETRY STUDY AREA

Figure 1



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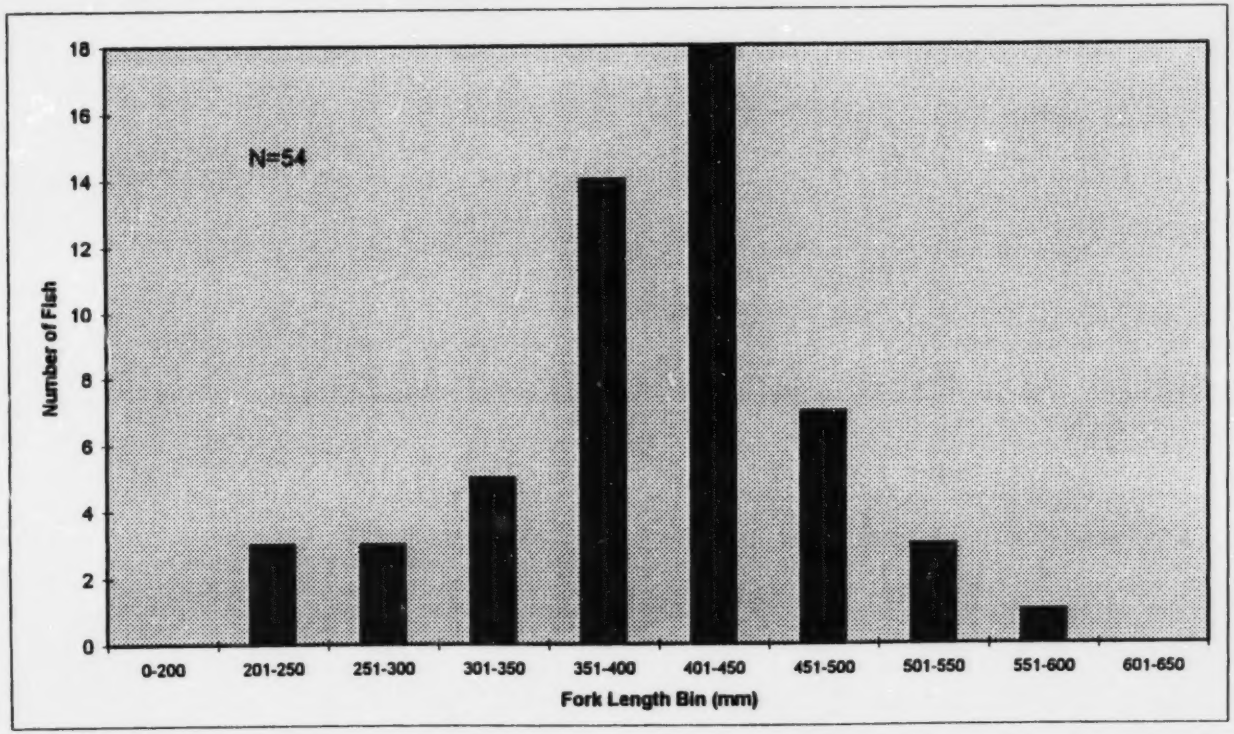

Figure 3. Length-frequency analysis for bull trout from the Oldman Reservoir study area, July 1995.

APPENDIX I

SUMMARY OF CAPTURE AND TAGGING INFORMATION FOR BULL TROUT FROM THE OLDMAN RESERVOIR STUDY AREA, JULY 1995

LEGEND

CAPTURE METHOD CODE

EF	Boat Electrofishing

LIFE HISTORY STAGE CODE

F	Fry
J	Juvenile
A	Adult
U	Unknown

SEX CODE

F	Female
M	Male
U	Unknown

STATE- OF- MATURITY CODE

IM	Immature
DV	Developing
GV	Gravid
RP	Ripe
SP	Spent
UN	Unknown

CAPTURE CODE

0	First capture, released
1	First capture, mortality
2	Second capture, released
3	Second capture, mortality

Date	Location	Method	Number	Length (mm)	Weight (g)	Stage	Sex	Maturity	Code	Number	Frequency	Comments
7-Jul	Castle River/Arm	EF	1	330	375	J	U	IM	0			
7-Jul	Castle River/Arm	EF	2	507	1372	A	F	DV	1			DNA sample
7-Jul	Castle River/Arm	EF	3	433	874	U	U	UN	0	B004265		
8-Jul	Crowsnest R./Arm	EF	4	500	2010	A	U	UN	1			DNA sample
8-Jul	Crowsnest R./Arm	EF	5	455	1004	U	U	UN	0	B004267	150.916	
8-Jul	Crowsnest R./Arm	EF	6	457	1075	U	U	UN	0	B004268	150.182	
8-Jul	Crowsnest R./Arm	EF	7	482	1324	A	U	DV	0	B004269	150.666	
8-Jul	Crowsnest R./Arm	EF	8	553	1989	A	U	DV	0	B004270	150.598	
8-Jul	Crowsnest R./Arm	EF	9	480	1541	A	F	DV	1			DNA sample
8-Jul	Crowsnest R./Arm	EF	10	479	1340	A	U	DV	0	B004272	150.538	
8-Jul	Crowsnest R./Arm	EF	11	397	662	J	U	IM	0	B004273		DNA sample
8-Jul	Crowsnest R./Arm	EF	12	410	768	U	U	UN	0	B004274		DNA sample
8-Jul	Crowsnest R./Arm	EF	13	296	319	J	U	IM	0	B004275		DNA sample
9-Jul	N.L. Oldman R./Arm	EF	14	501	1219	A	U	DV	0	B004276	150.687	
9-Jul	N.L. Oldman R./Arm	EF	15	439	1010	U	U	UN	0	B004277	150.337	
9-Jul	N.L. Oldman R./Arm	EF	16	290	289	J	U	IM	0			DNA sample
9-Jul	N.L. Oldman R./Arm	EF	17	365	519	J	U	IM	0	B004278		
9-Jul	N.L. Oldman R./Arm	EF	18	382	635	J	U	IM	0	B004279		DNA sample
9-Jul	N.L. Oldman R./Arm	EF	19	385	590	J	U	IM	0	B004280		DNA sample
9-Jul	N.L. Oldman R./Arm	EF	20	390	605	J	U	IM	0	B004281		DNA sample
10-Jul	Castle River/Arm	EF	21	385	560	J	U	IM	0	B004297		DNA sample
10-Jul	Castle River/Arm	EF	22	408	670	U	U	UN	0	B004282		DNA sample
11-Jul	Crowsnest R./Arm	EF	23	333	350	J	U	IM	0			DNA sample
11-Jul	Crowsnest R./Arm	EF	24	400	650	J	U	IM	0			DNA sample
11-Jul	Crowsnest R./Arm	EF	25	514	1510	A	U	DV	0	B004287	150.741	
11-Jul	Crowsnest R./Arm	EF	26	470	1160	A	U	DV	0	B004288	150.880	
11-Jul	Crowsnest R./Arm	EF	27	408	830	U	U	UN	0	B004289	150.138	
11-Jul	Crowsnest R./Arm	EF	28	410	950	U	U	UN	1			
12-Jul	N.L. Oldman R./Arm	EF	30	235	120	J	U	IM	0			DNA sample
12-Jul	N.L. Oldman R./Arm	EF	31	396	580	J	U	IM	0			DNA sample
12-Jul	N.L. Oldman R./Arm	EF	32	313	270	J	U	IM	0	B004292		DNA sample
12-Jul	N.L. Oldman R./Arm	EF	33	399	670	J	U	IM	0	B004293		DNA sample
13-Jul	Crowsnest R. Mouth	EF	34	404	780	U	U	UN	0	B004294		DNA sample
13-Jul	Crowsnest R. Mouth	EF	35	378	740	J	U	IM	0	B004295		DNA sample
13-Jul	Crowsnest R. Mouth	EF	36	445	650	U	U	UN	0	B004296		DNA sample
13-Jul	Crowsnest R. Mouth	EF	37	435	980	U	U	UN	0	B004298	150.284	
13-Jul	Crowsnest R. Mouth	EF	38	401	660	U	U	UN	0	B004299		DNA sample
13-Jul	Crowsnest R. Mouth	EF	39	405	720	U	U	UN	0	B004300		DNA sample
13-Jul	Crowsnest R. Mouth	EF	40	385	710	J	U	IM	0	B004474		DNA sample
14-Jul	N.L. Oldman R./Arm	EF	41	230	120	J	U	IM	0			DNA sample
14-Jul	N.L. Oldman R./Arm	EF	42	415	680	U	U	UN	0	B004451		DNA sample
14-Jul	N.L. Oldman R./Arm	EF	43	398	600	J	U	IM	0	B004452		DNA sample

Appendix I - Summary of capture and tagging information for bull trout from the Oldman Reservoir Study Area, July 1995.

Date	Location	Capture Method	Fish Number	Fork Length (mm)	Weight (g)	Stage	Sex	Maturity	Capture Code	Floy Tag Number	Radio Tag Frequency	Comments
14-Jul	N.L. Oldman R./Arm	EF	44	425	850	U	U	UN	0	B004453	150.442	
14-Jul	N.L. Oldman R./Arm	EF	45	437	870	U	U	UN	0	B004454	150.715	
14-Jul	N.L. Oldman R./Arm	EF	46	449	1060	U	U	UN	0	B004455	150.580	
14-Jul	N.L. Oldman R./Arm	EF	47	315	380	J	U	IM	0	B004456		DNA sample
14-Jul	N.L. Oldman R./Arm	EF	48	413	790	U	U	UN	0	B004457		DNA sample
14-Jul	N.L. Oldman R./Arm	EF	49	337	430	J	U	IM	0	B004458		DNA sample
14-Jul	N.L. Oldman R./Arm	EF	50	405	820	U	U	UN	0	B004459	150.385	
15-Jul	Castle River/Arm	EF	51	383	510	J	U	IM	0	B004460		DNA sample
15-Jul	Castle River/Arm	EF	52	403	520	U	U	UN	0	B004461		DNA sample
15-Jul	Castle River/Arm	EF	53	374	405	J	U	IM	0	B004462		DNA sample
15-Jul	Castle River/Arm	EF	54	268	250	J	U	IM	0			DNA sample
15-Jul	Castle River/Arm	EF	55	216	120	J	U	IM	0			DNA sample

APPENDIX II

INDIVIDUAL BULL TROUT TELEMETRY LOCATIONS, OLDMAN RIVER BASIN, 1995